U. S. DEPARTMENT OF HOMELAND SECURITY U.S. COAST GUARD CG-3303C-8 (Rev. 02-03)	**RECORD OF PERFORMANCE QUALIFICATIONS EM**

INSTRUCTIONS

Record of Performance Qualifications shall be completed for enlisted personnel of the Coast Guard as outlined in the Enlisted Performance Qualifications Manual, COMDTINST M1414.8 (series). As proficiency in each performance qualification is demonstrated by actually performing the task listed, the DATE and INITIALS column shall be completed. Personnel are required to demonstrate proficiency in all new performance qualifications assigned to their rating. Performance qualifications previously demonstrated, dated and initialed off will not be recertified. Some performance qualifications include intent statements to help clarify the requirements of the task that is to be performed.

This revision to the EM EPQs does not change any of the previous tasking. It only adds references and provides links to the reference material. Therefore, the SWE effective dates remain unchanged and if members have completed tasks on the previous edition of the EM EPQs, then signatures should be transferred for those completed tasks to this new edition.

RATING	**ABBREVIATION**
ELECTRICIAN'S MATE (Effective for the NOV 2002 Active Duty and the OCT 2003 Reserve SWE)	EM

DATE COMPLETED ALL PERFORMANCE QUALIFICATIONS FOR RATE LEVEL

E-4	**E-5**	**E-6**
E-7	**E-8**	**E-9**

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SIGNATURE OF SUPERVISOR

DATE	NAME/SIGNATURE	INITIALS	RATE	UNIT

REMARKS

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A. ADMINISTRATION

4.01 **Prepare** and **maintain** Megger Card Files IAW the Naval Engineering Manual, COMDTINST M9000.6 (series), and CMPlus User Manual.

***Intent**: The member should understand the purpose for insulation resistance to ground trend analysis. The member should ensure appropriate insulation resistance to ground entries are made on megger cards and follow procedures for reporting negative trends.*

4.02 **Maintain** portable electrical tools log IAW applicable unit Preventative Maintenance System (PMS).

***Intent**: The member should maintain an accurate inventory of all portable tools at your unit and identify the personnel responsible for them. The member should track the portable electrical tools and make entries required by the Preventative Maintenance System for portable electrical tool checks.*

4.03 **Maintain** the tag-out and instrument log IAW the Equipment Tag-out Procedure, COMDTINST 9077.1 (series).

***Intent**: The member should ensure information entered into the log is correct, including the serial numbering system, the list of Authorizing Officers, and blank pages are available for entries, in both Engineering and Operations tag-out logs and IAW published guidelines.*

5.01 **Research** part numbers and prices for parts needed at your unit IAW the Supply and Policy Procedures Manual (SPPM), COMDTINST M4400.19A (series) and CMPlus User Manual and FEDLOG user manual and tutorial.

***Intent**: The member should identify current part number, source of supply, price, and availability for consumables and material required for corrective and preventative maintenance using FED LOG & CM Plus IAW published guidelines.*

5.02 **Prepare** a procurement request IAW the Supply and Policy Procedures Manual (SPPM), COMDTINST M4400.19A (series), CMPlus User Manual and LUFS.

***Intent**: The member should prepare required forms for obtaining parts through both commercial and federal supply systems IAW published guidelines.*

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5.03 **Perform** the following within your unit Preventative Maintenance Program IAW the Naval Engineering Manual, COMDTINST M9000.6 (series) and/or CMPlus User Manual, for electrical equipment.

a. Provide recommended updates to the Preventative Maintenance System.
b. Review current Maintenance Procedure Cards (MPC's) for accuracy.
c. Schedule unit PMS.
d. Submit required PMS reports.

***Intent**: The member should understand how to complete changes to, review accuracy of, schedule, and submit reports for, Preventative Maintenance System procedures. The member should ensure that the procedures are carried out and appropriate information is entered into the CM Plus maintenance tracking system IAW published guidelines.*

5.04 **Audit** the tag-out log IAW the Equipment Tag-out Procedure, COMDTINST 9077.1 (series).

***Intent**: The member should ensure that information entered into the tag out log is accurate, including the proper equipment name, tag locations, currently authorized personnel signatures are entered on the tags and the log, the serial number sequence is maintained, and the audit entry is completed IAW published guidelines.*

6.01 **Prepare** and **submit** a divisional budget IAW all current Coast Guard and Unit instructions.

***Intent**: The member should use historical budgetary data, pending unit projects, and current unit shortfalls to submit a budget via your chain of command.*

6.02 **Prepare** a Current Ship's Maintenance Project (CSMP) IAW the Naval Engineering Manual, COMDTINST M9000.6 (series).

***Intent**: The member should draft and submit an accurate CSMP for their own unit's upcoming dockside or dry-dock availability, ensuring all applicable specifications are addressed, the proper drawings are used as reference, cost estimates are obtained, safety and habitability concerns are addressed, and the project description accurately reflects the scope of work required.*

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6.03 **Prepare** and **maintain** Machinery History files IAW the Naval Engineering Manual, COMDTINST M9000.6 (series), and/or CMPlus User Guide.

***Intent**: The member should understand the purpose of maintaining Machinery history files. The member should inventory Machinery History cards to ensure all equipment prescribed by the Preventative Maintenance System is monitored. The member should ensure appropriate maintenance entries are made on the cards and make the appropriate Machinery History entries into CM Plus, ensuring all prescribed data is entered.*

6.04 **Prepare** the following casualty report (CASREP) messages IAW the Casualty Reporting (CASREP) Procedures (Materiel), COMDTINST M3501.3 (series), Operational Reports, NWP 1-03.1 chapter 2 (series), MLC Standard Operating Procedures (MLCLANT SOP, MLCPAC SOP), and CMPlus User Manual.

a. Initial
b. Update
c. Correction
d. Cancellation

***Intent**: The member should be able to demonstrate the ability to initiate, modify, and complete a Maintenance Action and the series of CASREP messages associated with the Maintenance Action, on failed equipment at your unit.*

6.05 **Submit** an Allowance Change Request (ACR) via Chain of Command to ELC, IAW applicable CALMS/MICA manuals.

***Intent**: The member should be able to determine the proper quantity and type of renewal parts or consumables, storage requirements, and prepare the information IAW published guidelines to correct discrepancies in the Combined Onboard Spare Parts Allowance.*

7.01 **Compare** the contents of an approved Current Ships Maintenance Project (CSMP), or Shore Side Maintenance Request (SSMR) with the associated Statement of Work, IAW the Naval Engineering Manual, COMDTINST M9000.6 (series), MLC specifications (LANT SPECS, PAC SPECS), and the Civil Engineering Manual, COMDTINST M11000.11 (series).

***Intent**: The member should be able to compare the CSMP, or SSMR to contained in the Statement of Work to ensure the proper drawings, references & materials have been used and safety considerations are properly addressed and installation is correctly located.*

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B. GENERAL

4.01 **Operate** the following test equipment as part of a maintenance or repair procedure on Coast Guard equipment IAW the Manufacturers Technical Manuals and Naval Ships Technical Manual, Chapter 491, Electrical Measuring and Test Instruments.

a. Analog multimeter
b. Clamp-on ammeter
c. Digital multimeter
d. Megohmmeter
e. Phase sequence indicator
f. Portable voltage tester

***Intent**: The member should demonstrate the proper use of test equipment to measure AC and DC voltage, AC and DC current, resistance, insulation-resistance-to-ground of electrical circuits and the correct phase sequence on multi-phase electrical circuits, ensuring all safety precautions are followed.*

4.02 **Install** the following connectors as part of a maintenance or repair procedure on Coast Guard equipment IAW the Electronics Installation and Maintenance Handbook (EIMB) Standards, NAVSEA 0910-LP-003-9770, MIL-HDBK-1277 Handbook for Splices, Terminals, Terminal Boards, Binding Posts, Terminal Junctions Systems, Wire Caps; Electrical, and DOD-STD-2003 (SH) Electric Plant Installation Standard Methods for Surface Ships and Submarines, Section 5 (Connectors).

a. BNC (crimp)
b. Crimp-on lugs and connectors
c. Multipin cannon plugs
d. RS-232
e. Solder-on lugs and connectors
f. UHF connector to coax

***Intent**: The member should understand the proper use of crimping tools, diagonal pliers, linemans pliers, and wire strippers to install the above connectors on cable ends to ensure proper continuity of an electrical circuit dependant upon application. In addition, the member should understand the proper application/situation for each connector used.*

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4.03 Using the following references, MIL-HDBK-299 (SH) Cable Comparison Handbook, Data Pertaining to Electric Shipboard Cable including Notice 1, IEEE STD 45, Naval Ships Technical Manual, Chapter 300 Electric Plant-General, Chapter 310 Power Generators and Conversion Equipment, Chapter 320 Electric Power Distribution Systems, Chapter 330 Lighting, MIL-HDBK-290 Standard Electrical Symbols List including Notice 1, and DOD-STD-2003 (SH) Electric Plant Installation Standard Methods for Surface Ships and Submarines, Sections 1 (Cable), 2 (Equipment), 3 (Penetrations), 4 (Cableways), 5 (Connectors), **install** the proper wire and cable system as part of a maintenance or repair procedure on Coast Guard equipment, including the following components:

a. Bandings
b. Cable
c. Cable tags
d. Connections
e. Hangers
f. Junction box
g. Plugs
h. Transits

***Intent**: The member should understand the proper installation procedures of wiring and cables from a load to a source. The member must determine the wiring/cable type, current requirement for the load, allowable voltage drop, cable length, suspension type and requirement, connections and protection, depending upon environmental conditions.*

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4.04 Given an electronic print and corresponding electronic components of Coast Guard equipment (for example Variable DC power supply, OWS, Gyro compass control circuit, Tank Level Indicator signal distribution card), **troubleshoot** a printed circuit board to component level IAW MIL-HDBK-198, Capacitors, Selection And Use Of, MIL-HDBK-199 Resistors, Selection And Use Of, and MIL-HDBK-5961A List of Standard Semiconductor Devices, to include the following components.

a. Capacitor
b. Diode
c. Inductor
d. Resistor
e. Silicon Controlled Rectifier
f. Transistor

***Intent**: The member should understand the function of each component in the circuit to determine the cause of the component failure. The member should be able to explain nominal circuit operation including being able to analyze both AC and DC circuits using Ohm's Law, Kirchhoff's Law, etc., to determine expected electrical values, identify all failure symptoms and follow logical procedures to isolate the faulty component. The member must identify the lowest repairable failed component. The member must identify all tools, test equipment, and supplies required. The test equipment must include a digital multimeter, and an oscilloscope.*

4.05 Given the proper soldering equipment, **renew** a two lead (resistor, capacitor, diode, etc.) component IAW Coast Guard Module Test and Repair (MTR) Program, COMDTINST 4790.2 (series).

***Intent**: The member should demonstrate the proper procedure for renewing the above components, ensuring all applicable safety precautions including Electro-Static Discharge protection, dust protection, and fume protection and proper soldering practices.*

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5.01 **Verify** rotating machine speed using a hand held tachometer IAW Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 491 Electrical Measuring and Test Instruments, and Chapter 504 Pressure Temperature and Other Mechanical and Electromechanical Measuring Instruments.

***Intent**: The member should understand the relationship between the generator speed and generator frequency. The member should be able to measure the rotating speed of a generator using a handheld tachometer and using appropriate formula calculate the expected frequency for comparison to the nominal generator frequency.*

5.02 **Troubleshoot** the following sensors and/or transducer types as part of a maintenance, or repair procedure on Coast Guard equipment IAW Manufacturers Technical Manual, Naval Ships Technical Manual 504 Pressure Temperature and Other Mechanical and Electromechanical Measuring Instruments, and MIL-HDBK-298 Selection, Installation and Troubleshooting of Resistance Thermometers and Thermocouple Sensors:

a. 4-20mA
b. RTD
c. Thermocouple

***Intent**: The member should understand the theory of operation of the above sensors and transducer types for monitoring pressure, flow, vacuum, and temperature. The member should be able to demonstrate the proper procedure for locating a faulted sensor or transducer. The member should be able to demonstrate the procedure for checking the calibration of suspect sensors or transducers, and affect repairs or adjust the sensor or transducer to restore the circuit to proper operation.*

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C. SAFETY

4.01 **Don** required safety equipment for the following:

a. Battery maintenance IAW the Naval Ships Technical Manual, Chapter 313, Portable Storage and Dry Batteries.
b. Repair Party Electrician IAW Naval Ships Technical Manual, Chapter 555 Volume 1 Surface Ship Firefighting.
c. Volatile lamps IAW the Naval Ships Technical Manual, Chapter 422, Navigation and Signal Lights.
d. Working aloft IAW the Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19 (series).

***Intent**: The member should identify the proper safety equipment required for working on the above systems, or conditions. The member should ensure the proper inspection of safety equipment is completed prior to donning the above safety equipment and performing maintenance on the above systems.*

4.02 **Dispose** of batteries IAW the Hazardous Waste Management Manual, COMDTINST M16478.1 (series) and Naval Engineering Manual, COMDTINST M9000.6 (series).

***Intent**: The member should understand the safety requirements to be considered when disposing of both primary and secondary cells, or batteries. The member should understand the requirement for stowing and packaging different battery types, paying particular attention to chemical reactivity, which can occur if dissimilar battery types are stowed together. The member should understand the requirements to properly package and stow batteries for shipment to the disposal sight, following all applicable published guidelines. The member should complete all required paperwork required for proper battery disposal, ensuring all applicable published guidelines are followed.*

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4.03 **Dispose** of lamps IAW the Naval Ships Technical Manual, Chapter 330 Lighting, and the Hazardous Waste Management Manual, COMDTINST M16478.1 (series).

***Intent**: The member should understand the safety requirements when disposing of all lamp types, paying particular attention to potential release of hazardous waste, including mercury, to the environment. Particular attention should also be paid to the potential for explosion on High Intensity Discharge and searchlight bulbs. The member should properly package and stow all lamp types for shipment to the disposal sight, following all applicable published guidelines. The member should complete all required paperwork required for proper lamp disposal, ensuring all applicable published guidelines are followed.*

4.04 **Perform** a Tag-Out IAW the Equipment Tag-Out Procedure, COMDTINST 9077.1 (series).

***Intent**: The member should understand the requirements for equipment tag-out of all engineering systems. The member should demonstrate the ability to open all sources of power to the circuit, closing all valves on a liquid, or pneumatic system, disabling all starting devices for rotating machines, and disabling/enabling mechanical lockout systems. The member should demonstrate an equipment tag-out acting as the person attaching the tag and as the person checking the tag. The member should demonstrate an equipment tag-in acting as the person removing the tag and as the person checking the tag removal. The member should understand when the equipment or system could be placed back in operation. The member should understand the requirements for acting as the Authorizing Officer. The member should understand the requirements for acting as a Repair Activity Representative.*

4.05 **Perform** a portable electric tool safety check IAW the Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19 (series), and the Naval Ships Technical Manual, Chapter 300 Electric Plant-General.

***Intent**: The member should be able to understand the causes and effects of insulation breakdown on portable tools. The member should determine the safety state of portable electrical tools, including the insulation resistance to ground and the resistance of the ground conductor from the case to the ground terminal. The member should demonstrate the procedures for conducting a portable electric tool safety check and identify those conditions under which a portable electric tool would fail the safety check following all Preventative Maintenance Procedures.*

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D. AUXILIARY CONTROL SYSTEMS

4.01 **Troubleshoot** the common faults associated with an auxiliary equipment control circuit as part of a maintenance, or repair procedure on Coast Guard equipment IAW Manufacturers Technical Manual and the Naval Ships Technical Manual, Chapter 221 Boilers, Chapter 300 Electric Plant-General, Chapter 430 Interior Communications Installations, Chapter 504 Pressure Temperature and Other Mechanical and Electromechanical Measuring Instruments, Chapter 510 Heating Ventilating and Air Conditioning Systems for Surface Ships, Chapter 516 Refrigeration Systems, and Chapter 593 Pollution Control, to include the following components:

a. Float switch
b. Flow switch
c. Interlock
d. Level switch
e. Limit switch
f. Pressure switch
g. Proximity switch
h. Relay
i. Solenoid
j. Temperature switch
k. Timer

***Intent**: The member should understand the theory of operation and intended purpose of the above components in auxiliary control circuits. The member should demonstrate the proper procedure for determining faulted control circuit components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation.*

5.01 **Troubleshoot** the electrical components of a steering system IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 562 Surface Ship Steering Systems and MIL-HDBK-225A Synchros Description and Operation.

***Intent**: The member should understand the theory of operation of a steering system to determine the cause of the failure. The member should be able to demonstrate the proper procedure for determining a faulted steering system electrical component, to include repeaters, electro-hydraulic actuators, and solenoid valves. The components must be adjusted and/or renewed to restore the steering system to proper operation.*

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5.02 **Troubleshoot** a window/windshield wiper system IAW the Manufacturers Technical Manual.

***Intent**: The member should understand the theory of operation of a window/windshield wiper system to determine the cause of the failure. The member should demonstrate the proper procedure for determining a faulted window/windshield wiper system electrical component, to include the motor, the speed control rheostat, the power supply/rectifier assembly, and wiper arm gear train. The components must be adjusted and/or renewed to restore the window/windshield wiper system to proper operation.*

6.01 **Troubleshoot** governor control systems IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 233 Diesel Engines, and Chapter 310 Electric Power Generation.

***Intent**: The member should understand the theory of operation of a governor control system. The member should be able to demonstrate the proper procedure for determining a faulted power generation governor control system component to include the electronic governor control, the magnetic pickup, the mechanical and electrical droop adjustments, and the over speed circuit. The member should be able to demonstrate the proper procedure for determining a faulted propulsion governor control system component, including the magnetic pickup, and the voltage to pneumatic signal converter. The member must understand how to adjust and/or renewed components to restore the system to proper operation.*

6.02 **Troubleshoot** an autopilot system IAW the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 562 Surface Ship Steering Systems.

***Intent**: The member should understand the theory of operation of an autopilot system. The member should demonstrate the proper procedure for determining a faulted autopilot system component to include the gyro input circuit, rudder feedback, sea state compensation circuit, weather state compensation circuit, heading order circuit, and the steering mode selector circuit. Additionally, the following circuits may be included, the Dynamic Positioning System circuit, and Global Positioning System circuit. The member must understand how to adjust and/or renewed components to restore the system to proper operation.*

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6.03 **Troubleshoot** an electrical cathodic protection system IAW the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 633 Cathodic Protection.

***Intent**: The member should understand the theory of operation of a cathodic protection system. The member should demonstrate the proper procedure for determining a faulted cathodic protection system components to include the power supply, the controller, the anode, the reference electrode, the shaft ground assembly, the rudder ground (including stabilizer if installed), and the dielectric shield. The member should ensure that the system output is entered into the Cathodic Protection Log for the purpose of trend analysis. The member must understand how to adjust and/or renewed components to restore the system to proper operation.*

6.04 **Troubleshoot** boiler electrical systems IAW the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 221 Boilers.

***Intent**: The member should understand the theory of operation of a boiler electrical system. The member should be able to demonstrate the proper procedure for determining a faulted boiler electrical system to include the flame sensor circuit, the ignition electrodes, the pressure control circuits, the water control circuits, the fuel oil control circuits, and the temperature control circuits. The member must understand how to adjust and/or renewed components to restore the system to proper operation.*

E. BATTERIES

4.01 **Install** multiple batteries IAW the Naval Ships Technical Manual Chapter 313, Portable Storage and Dry Batteries to include the following configurations:

a. Parallel
b. Series
c. Series-Parallel

***Intent**: The member must understand the theory of series, parallel, and series-parallel circuits for calculating desired voltage and current. The member must be able to demonstrate connecting batteries in series, parallel, and series-parallel to obtain the desired voltage and current requirements, observing all safety precautions.*

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4.02 **Maintain** batteries IAW the Naval Ships Technical Manual, Chapter 313 Portable Storage and Dry Batteries, Chapter 400 Electronics, and applicable unit Preventative Maintenance Procedures to include the following:

a. Add distilled water
b. Charge batteries IAW the Manufacturers Technical Manual
c. Check electrolyte specific gravity, interpret and record readings
d. Clean a hydrometer IAW the Manufacturers Technical Manual
e. Clean batteries and lubricate terminals
f. Fill batteries with pre-mixed electrolyte

***Intent**: The member should understand the theory of operation for batteries and their construction. The member should understand the relationship between the specific gravity of the electrolyte and the electrolyte temperature. The member must understand the reason for an initial charge, a normal charge, a boost charge, and a floating charge. The member must demonstrate the proper method of placing batteries in service and/or maintaining batteries in a ready state, following all applicable safety precautions.*

4.03 **Maintain** battery chargers by adjusting the output IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 313 Portable Storage and Dry Batteries, and all applicable unit Preventative Maintenance Procedures.

***Intent**: The member should understand the theory of operation of a battery charger. The member should be able to demonstrate the proper method of maintaining battery charger in a ready state, following all applicable safety precautions. Particular attention should be paid to adjusting the battery charger to maintain the connected batteries in a ready state.*

5.01 **Troubleshoot** battery chargers to component level IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 300 Electric Plant-General, and Chapter 313 Portable Storage and Dry Batteries.

***Intent**: The member should understand the theory of operation of a battery charger system. The member should be able to demonstrate the proper procedure for determining a faulted battery charger system component to include, the input circuit breaker/fuses, the rate selector switch, the transformer, the solid-state rectifier, the output fuses. The member should understand how to adjust and/or renewed components to restore the system to proper operation.*

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F. DECK MACHINERY EQUIPMENT

4.01 **Maintain** electrical and electronic components of deck machinery IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 581 Anchoring, Chapter 589 Cranes, and all applicable Preventative Maintenance Procedures.

***Intent**: The member should understand the electrical theory of operation of deck machinery. The member should demonstrate the ability to determine the proper operating state of interlock switches, proximity switches, limit switches, load cells, operating switches, heater elements, quick disconnects, cannon plugs, and electromagnetic brakes of deck machinery equipment to ensure proper equipment operation.*

4.02 **Troubleshoot** the common faults associated with electrical and electronic components of deck machinery IAW the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 302 Electric Motors and Controllers.

***Intent**: The member should understand the theory of operation of deck machinery systems to determine the cause of the failure. The member should demonstrate the proper procedure for determining a faulted deck machinery system component to include, interlock switches, proximity switches, limit switches, load cells, operating switches, heater elements, quick disconnects, cannon plugs, and electromagnetic brakes. The member must understand how to adjust and/or renewed components to restore the system to proper operation.*

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G. GALLEY, SCULLERY, AND LAUNDRY EQUIPMENT

4.01 **Troubleshoot** the common faults associated with the following equipment IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 510 Heating Ventilating and Air Conditioning Systems for Surface Ships, Chapter 512 Fans, Chapter 651 Commissary Equipment, Chapter 655 Laundry and Dry Cleaning, and NAVSEA S9555 AR-MMO-010 Range Guard Fire Extinguishing System.

a. Deep fat fryer
b. Galley equipment
c. Galley fire suppression system
d. Galley ventilation system
e. Laundry equipment
f. Scullery equipment

***Intent**: The member should understand the theory of operation of the above equipment. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the equipment to proper operation.*

H. GENERATORS, MOTORS AND CONTROLLERS

4.01 **Troubleshoot**, to the component level the common faults associated with a non-electronic controller IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 300 Electric Plant-General, and Chapter 302 Electric Motors and Controllers, to include the following components:

a. Auxiliary contacts
b. Contactor
c. Control transformer
d. Fuses
e. Interlocks
f. Overloads
g. Relays
h. Switches
i. Timers

***Intent**: The member should understand the theory of operation and intended purpose of the above components in a non-electronic controller. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation.*

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4.02 **Troubleshoot** the common faults associated with a Silicon Controlled Rectifier (SCR) drive controller IAW the Manufacturers Technical Manual.

***Intent**: The member should understand the theory of operation of a Silicon Controlled Rectifier (SCR) drive controller. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation.*

5.01 **Renew** a direct drive AC motor IAW the manufacturers Technical Manual, and Naval Ships Technical Manual, Chapter 503 Pumps.

***Intent**: The member should demonstrate the ability to renew a direct drive AC motor, following all applicable safety precautions. The member should understand the importance of proper motor-to-equipment alignment and soft foot adjustments. The member should demonstrate proper motor-to-equipment alignment procedures and soft foot adjustments to minimize vibration, excessive torque, and wear.*

5.02 **Maintain** motors and generators (AC and DC) IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 244 Propulsion Bearings and Seals, Chapter 300 Electric Plant General, Chapter 302 Electric Motors and Controllers, and Chapter 310 Electric Power Generators and Conversion Equipment to include the following:

a. Check air gap
b. Check phase balance/rotation
c. Check winding temperature
d. Inspect brushes
e. Inspect brush riggings
f. Renew bearing
g. Renew brushes

***Intent**: The member should understand the reason for performing the above tasks to ensure optimal motor and generator performance. The member should be able to demonstrate the proper method of performing the above tasks.*

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I. INTERIOR COMMUNICATIONS SYSTEM

4.01 **Troubleshoot** sound powered phone system IAW the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 430 Interior Communications Installations.

***Intent**: The member should understand the theory of operation of a sound powered phone system. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, and shorts.*

4.02 **Troubleshoot** call bell system IAW the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 430 Interior Communications Installations.

***Intent**: The member should understand the theory of operation of a call bell system. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, and shorts.*

4.03 **Troubleshoot** a common fire alarm system IAW the Manufacturers Technical Manual.

***Intent**: The member should understand the theory of operation of a fire alarm system. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. The member should understand detector location requirement, including heat sensing and ionization type detectors, to ensure the proper type of detection. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, and the terminating resistor requirement.*

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5.01 **Troubleshoot** rudder angle indicator system IAW the Manufacturers Technical Manual and MIL-HDBK-225A Synchros Description and Operation.

***Intent**: The member should understand the theory of operation of a synchro driven rudder angle indicator system, to include receivers, transmitters, and current transform. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the system to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, proper connection of stator and rotor leads for correct synchro system response, and the criticality of adjusting the stacked switch which controls rudder feedback.*

5.02 **Troubleshoot** wind direction (HD) and speed (HE) indicator system IAW the Manufacturers Technical Manual and MIL-HDBK-225A Synchros Description and Operation.

***Intent**: The member should understand the theory of operation of a synchro driven wind direction (HD) and speed (HE) indicator system, to include receivers, transmitters. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, proper connection of stator and rotor leads for correct synchro system response, and proper alignment of the direction detector to the ship centerline.*

5.03 **Troubleshoot** salinity indicator system IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 531 Desalination Volume 1 Low-Pressure Distilling Plants, Volume 2 Vapor Compression Distilling Plants, Volume 3 Reverse Osmosis Desalination Plants, and NAVSEA SN576-AE-MMA-010/00062 Salinity Indicating Equipment, Installation, Operation, Maintenance and Repair Instructions.

***Intent**: The member should understand the theory of operation of a salinity indicator system. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the system to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, and the temperature compensation circuit.*

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5.04 **Troubleshoot** the common faults associated with the following Interior Communications (IC) Alarm systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, 079 Volume 2 Damage Control-Practical Damage Control, and Chapter 430 Interior Communications Installations:

a. Bilge flooding (FD)
b. CO_2 flooding (FR)
c. High temperature (F)
d. Intrusion alarm (FZ)
e. Loss of ventilation (HF)

***Intent**: The member should understand the theory of operation and intended purpose of the above Interior Communications systems to include the following types of switches/detectors: level (FD), flow (FR and HF), temperature (F), and supervised (FZ). The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation.*

5.05 **Conduct** preventive maintenance procedures on a basic gyrocompass and associated equipment IAW applicable unit Preventative Maintenance System (PMS), the Manufacturers Technical Manual and Naval Ships Technical Manual, Chapter 420 Navigation Systems Equipment and Aids.

***Intent**: The member should understand the theory of operation of a gyrocompass system and it's associated equipment including the Electronic Control Unit, (ECU), switching unit, power converter, repeaters, signal amplifiers, and alarm and error detection circuits. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, proper connection of stator and rotor leads for correct repeater response, and proper alignment of the gyro sphere to the ship centerline.*

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J. LIGHTING SYSTEMS

4.01 **Troubleshoot** the common faults associated with the following lighting systems:

a. Battery operated portable and permanent lighting systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 330 Lighting, and DOD-HDBK-289 Lighting on Naval Ships.
b. Deck lighting systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 330 Lighting, and DOD-HDBK-289 Lighting on Naval Ships.
c. Explosion-proof lighting systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 330 Lighting, and DOD-HDBK-289 Lighting on Naval Ships.
d. Fluorescent lighting systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 330 Lighting, and DOD-HDBK-289 Lighting on Naval Ships.
e. Incandescent lighting systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 330 Lighting, and DOD-HDBK-289 Lighting on Naval Ships.
f. Navigational lighting systems IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 422 Navigational and Signal Lights, and DOD-HDBK-289 Lighting on Naval Ships.

***Intent**: The member should understand the theory of operation and intended purpose of the above normal and emergency lighting systems including, voltage sensitive relays operating, contacts, switches, ballasts, starters, bulbs, and fixtures. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, maintaining seal integrity of explosion-proof fixtures, the environmental conditions under which explosion-proof fixtures can be maintained, and the criticality of dual filament bulbs in navigation lighting systems.*

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4.02 **Troubleshoot** darken ship switches IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 330 Lighting, and DOD-HDBK-289 Lighting on Naval Ships.

***Intent**: The member should understand the theory of operation of darken ship switches to restore the equipment to proper operation. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, shorts, and the proper adjustment of the switch.*

4.03 **Troubleshoot** search/signal lights IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 422 Navigation and Signal Lights, and DOD-HDBK-289 Lighting on Naval Ships.

***Intent**: The member should demonstrate the proper procedure for determining faulted components to include; starting circuit, operating circuit, ballast circuit, chassis, and the yoke. The member must understand how to adjust/renew defective components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: proper handling of bulbs to prevent premature failure or explosion, and reflector cleanliness.*

4.04 **Troubleshoot** the common faults associated with the telltale panels IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 422 Navigation and Signal Lights, and DOD-HDBK-289 Lighting on Naval Ships.

***Intent**: The member should understand the theory of operation of telltale panels to restore the equipment to proper operation to include the annunciators, current sensitive relays, indicator lamps, buzzers, switches, fuses, and dimmer control. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation. Particular attention should be paid to identifying and correcting the following conditions: grounds, opens, and shorts.*

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5.01 **Troubleshoot** the common faults associated with the Visual Landing Aids (VLA) system IAW the Manufacturers Technical Manual, the Naval Air System Command, NAVAIR 51-50ABA-1 Air Capable Ships, and the Naval Air Technical Manual, NAVAIR 51-5B-2 Stabilized Glide Slope Indicator.

***Intent**: The member should understand the theory of operation of the Visual Landing Aids (VLA) system to restore the equipment to proper operation to include homing beacon, wave-off light, line up lights, extended line-up lights, Hot In Flight Refueling (HIFR) lights, deck surface floodlights, vertical drop line lights, touch down light, edge lights, control stations, motor driven variable transformers, and bulbs. The member should demonstrate the proper procedure for determining faulted components, renewal of the defective components, and/or adjustment of the components to restore the circuit to proper operation.*

K. POWER DISTRIBUTION SYSTEM

4.01 **Rig** the casualty power system IAW the Naval Ships Technical Manual, Chapter 079 Volume 3 Damage Control-Engineering Casualty Control.

***Intent**: The member should understand the purpose of the casualty power system. The member should demonstrate the ability to rig casualty power cable from load to source following all applicable safety precautions.*

4.02 **Perform** basic switchboard operations IAW Naval Ships Technical Manual, Chapter 310 Electric Power Generators and Conversion Equipment, Chapter 320 Electric Power Distribution Systems, and all local operating procedures.

***Intent**: The member should understand the theory of operation of a basic switchboard to include the following: monitoring equipment, circuit breakers, and control devices. The member should be able demonstrate the ability to parallel a generator to bus, parallel bus-to-bus, single up on a generator, balance true power load when in parallel, balance reactive load when in parallel, and maintain proper power factor.*

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4.03 **Troubleshoot** a basic electric power distribution system IAW Naval Ships Technical Manual, Chapter 300 Electric Plant General, and Chapter 320 Electric Power Distribution Systems.

***Intent**: The member should understand the theory of operation of a power distribution system to include the switchboard, transformers, load centers, bus transfer units, types and purpose of circuit breakers, the purpose of selective tripping, switches, and junction boxes. The member should demonstrate the ability to interpret electrical distribution system prints to include: cable length, cable size, cable type, load, physical components location, and source.*

5.01 **Troubleshoot** the following power distribution system components IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 300 Electric Plant General, and Chapter 320 Electric Power Distribution Systems.

a. Bus transfer equipment (Both automatic and manual bus transfer units)
b. Distribution circuit breakers
c. Distribution panels
d. Ground detection systems
e. Load centers
f. Power factor correction equipment
g. Power transformers
h. Shore tie cables
i. Shore tie connectors
j. Shore tie receptacles

***Intent**: The member should understand the theory of operation and intended purpose of the above power distribution system components. The member should demonstrate the proper procedure for determining faulted components, isolation of the defective components, renewal of the defective components, and/or adjustment of the components to restore the system to proper operation.*

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5.02 **Troubleshoot** a switchboard, to the component level, IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 300 Electric Plant General, Chapter 320 Electric Power Distribution Systems, and Chapter 491 Electrical Measuring and Test Instruments, for the following components:

a. Circuit breakers
b. Indicating lights
c. Meters – Voltmeter, Ammeter, Frequency meter, Wattmeter, Synchroscope, Power Factor, Phase Sequence Indicator
d. Potential and Current transformers
e. Potentiometer
f. Reverse Power Relay
g. Rheostat
h. Speed control circuit
i. Synchronizer
j. Voltage regulators

***Intent**: The member should understand the theory of operation and intended purpose of the above switchboard components. The member should demonstrate the proper procedure for determining faulted components, isolation of the defective components, renewal of the defective components, and/or adjustment of the components to restore the system to proper operation.*

5.03 **Troubleshoot** the common faults associated with the following power conversion equipment IAW the Manufacturers Technical Manual, Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 310 Power Generators and Conversion Equipment, Chapter 313 Portable Storage and Dry Batteries, Chapter 400 Electronics, and Chapter 420 Navigation Systems Equipment and Aids.

a. Converters
b. Motor-generator set
c. Static inverter
d. Uninterruptible Power Supply (UPS)

***Intent**: The member should understand the theory of operation and intended purpose of the above power conversion equipment. The member should demonstrate the proper procedure for determining faulted components, isolation of the defective components, renewal of the defective components, and/or adjustment of the components to restore the system to proper operation.*

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L. PROPULSION SYSTEMS

5.01 **Perform** air gap readings on propulsion motors and/or generators IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 300 Electric Plant General, Chapter 310 Electric Power Generators and Conversion Equipment, and all applicable Preventative Maintenance Procedures.

***Intent**: The member should understand the reason for performing air gap readings on propulsion motors and generators to ensure optimal motor and generator performance. The member should demonstrate the proper method of performing an air gap reading, and ensure all readings are recorded and compared to previous readings for trend analysis of bearing wear and internal component alignment.*

5.02 **Perform** Polarization Index Tests on propulsion motors and/or generators IAW the Manufacturers Technical Manual and the Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 300 Electric Plant General and all applicable Preventative Maintenance Procedures.

***Intent**: The member should understand the reason for performing dielectric absorption checks on propulsion motors and generators to ensure optimal motor and generator performance. The member should demonstrate the proper method of performing a dielectric absorption check, and ensure all readings are recorded and compared to previous readings for trend analysis of insulation dielectric strength.*

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6.01 **Maintain** the following components of a diesel-electric propulsion system IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 300 Electric Plant General, Chapter 310 Power Generators and Conversion Equipment, and all applicable Preventative Maintenance Procedures.

a. Brushes and brush riggings
b. Commutator
c. Connections
d. Exciters
e. Main contactors

***Intent**: The member should understand the reason for maintaining the above components to ensure optimal diesel-electric propulsion system performance. The member should demonstrate the proper method of determining the state of, and maintenance required to correct deficiencies in, the above diesel-electric propulsion components, following all applicable safety precautions.*

7.01 **Troubleshoot** a diesel-electric propulsion control system IAW the Manufacturers Technical Manual, the Naval Ships Technical Manual, Chapter 235 Electric Propulsion Installations, Chapter 300 Electric Plant General, and Chapter 310 Electric Power Generators and Conversion Equipment.

***Intent**: The member should understand the theory of operation of a diesel-electric propulsion system including the propulsion power plant electrical characteristics, feedback circuits and components, regulation circuits and components, and monitoring circuits and components, to include connections, exciters, main contactors, propulsion logic, input devices, output devices, and propulsion switchboard. The member should demonstrate the proper procedure for determining faulted components in the system, isolation of the defective components, renewal of the defective components, and/or adjustment of the components to restore the propulsion control system to proper operation.*

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M. SHORE POWER INSTALLATION

4.01 **Install** the following components IAW the National Electric Code Handbook (series).

a. Ballast (electronic and non-electronic)
b. Circuit breaker
c. Conduit
d. Ground Fault Circuit Interrupter (GFCI)
e. Receptacle-110 volt circuit
f. Receptacle-220 volt circuit
g. Single pole switch
h. Three-way switch

***Intent**: The member should understand the theory of operation and intended purpose of the above components. The member should demonstrate the ability to install a lighting circuit controlled from two locations. The member should demonstrate the ability to install a branch circuit requiring a GFCI from load to source with at least two convenience receptacles in the branch, on both the interior and exterior of a wall. The member should demonstrate the ability to install a 220 volt designated circuit from load to source, on the exterior of a wall. The member should understand the following requirements for bending conduit: size, number of conductors in the conduit, reaming and threading, coupling and connectors, the number of bends in a run, the radius of conduit bends and the exceptions, securing and supporting, splices and taps, bushings, and construction specification.*

4.02 Given a rigid bender (Hickey) and a one-shot bender, **bend** conduit, IAW the Manufacturers Technical Manual, to the following angles:

a. 45 degrees
b. 90 degrees
c. Offset

***Intent**: The member should understand the requirements for bending conduit to the above specifications to ensure the conduit provides the protection required for the conductors, taking into consideration, bend radius, conductor current capacity, heat dissipation and the number of conductors.*

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N. STANDARD BOAT ELECTRICAL SYSTEMS

4.01 **Maintain** the electrical system of a 41' UTB and/or 47' MLB IAW all applicable Preventative Maintenance Procedures, the Manufacturers Technical Manual, and the American Boat and Yacht (ABYC) Standards (series).

***Intent**: The member should understand how to maintain one of the above systems to ensure optimal performance to include the starting circuit, charging circuit, navigation light circuit, and alarm circuits. The member should be able to demonstrate the proper method of determining the state of, and maintenance required to correct deficiencies in either of the above electrical systems, following all applicable safety precautions.*

4.02 **Troubleshoot** the electrical system of a 41' UTB and/or 47' MLB IAW the Manufacturers Technical Manual, and the American Boat and Yacht (ABYC) Standards (series).

***Intent**: The member should understand the theory of operation of a UTB and /or MLB electrical system including the starting circuit, charging circuit, navigation light circuit, and alarm circuits. The member should demonstrate the proper procedure for determining faulted components in the system, isolation of the defective components, renewal of the defective components, and/or adjustment of the components to restore the UTB and/or MLB electrical system to proper operation.*

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TERMINOLOGY

AUDIT – An official examination and verification of accounts and records.

BEND – To force an object from a straight form into a curved one.

CALCULATE – Determine a value by mathematical methods, reasoning, or practical experience.

CONDUCT – To direct or control, lead, or guide.

DETECT – To discover or determine the existence, presence, or fact of.

DISPOSE – To put in a particular suitable place.

DON – To put on or dress in.

INSTALL – Place a new or modified system or equipment and/or software in service in accordance with established procedures, standards, specifications, drawings, directives, and policies.

INTERPRET – To explain or tell the meaning of.

MAINTAIN – All activities that serve to increase the mean-time-between-failure (MTBF) and/or decrease the total time inoperative (TTI) of equipment or systems.

OPERATE – To cause to function.

PERFORM – To carry out an action or pattern of behavior.

PREPARE – Plan, gather, and assemble information to produce a document (i.e. forms and schedules)

RENEW – To remove a defective component and install a unit with the same specifications in its place.

REPAIR – To restore a circuit or machinery to an as intended operational state.

RESEARCH – Systematically inquire into a subject in order to revise facts.

REVIEW - To examine a document or process for accuracy in content and/or format and report errors or updates to the author or controlling authority.

RIG – To put in condition or position for use.

SUBMIT - To prepare a report or form following a defined process and forwarding it to the prescribed authority.

TROUBLESHOOT – The process of locating and diagnosing faults in equipment by means of systemic checking or analysis and then affecting repair.

VERIFY – To determine the accuracy of recorded information by comparing to physical evidence.

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